Global mean sea-level rise (GMSLR) during the 20th century was primarily caused by glacier and ice sheet mass loss, thermal expansion of ocean water, and change of terrestrial water storage. Whether based on observations or results of climate models, the sum of estimates of each of these contributors tends to fall short of the observed GMSLR. All estimates of the glacier contribution to GMSLR rely on the application of glacier inventory data, which are known to under-sample the smallest glacier size classes. Here we show that missing glaciers (small glaciers that we expect to exist today, but which are not represented in the inventories) have contributed a substantial amount of water to GMSLR. From 1901 to 2015, we estimate a lower bound of their contribution at 12.3±1.6 mm SLE (sea-level equivalent), and an upper bound at 42.7±6.5 mm SLE. Because their total 2015 ice mass is estimated to be very small, between 2.1±0.3 and 2.4±0.4 mm SLE, their potential to impact future GMSLR is much smaller.

Additionally, disappeared glaciers that existed in 1901, but had completely melted away by 2015, which are not included in modern global glacier inventories, are estimated to have contributed between 4.4±1.4 and 5.3±2.4 mm SLE. Together, these uncharted glaciers (missing and disappeared glaciers combined) made an estimated contribution between 16.7±3.0 and 48.0±8.9 mm SLE. Failure to consider these glaciers may be an important cause of difficulties in closing the GMSLR budget during the 20th century: their contribution is on average between 0.17 and 0.53 mm SLE/yr, compared to a budget discrepancy of about 0.5 mm GMSLR/yr from1901 to 1990. From 1993 to 2010, their average contribution is between 0.08 and 0.21 mm SLE/yr, compared to a budget discrepancy of 0.4 mm GMSLR/yr. We suggest that accounting for uncharted glaciers in some fashion is essential for accurate historical glacier GMLSR contribution estimations.